REMARKS

Reconsideration and allowance of the subject application are respectfully requested.

Claim 1 has been amended by essentially incorporating the subject matter of claims 3 and 13. Claims 3 and 13 were accordingly cancelled. Due to the cancellation of claims 3 and 13, the dependency of claims 7 and 14 were revised as shown above. The remaining claims, amended as shown above, were revised to overcome the rejections under 35 USC 112, second paragraph, as described below.

Claims 1, 2, 4, 5 and 12 stand rejected under 35 USC 112, second paragraph because the Examiner finds these claims to be indefinite for the reasons stated at page 2 of the Office Action.

As suggested by the Examiner, claim 2 has been amended to recited elements of Group 4 of the Periodic Table. This amendment is supported in the specification including at page 9, line 25 to page 10, line 2. Claim 5 has been cancelled as being redundant.

In response to the rejection of claim 4 for insufficient antecedent basis, claim 4 has been amended to depend on claim 2, as shown above.

In response to the Examiner's rejection of claim 12, the word "compound" has been inserted at the location suggested by the Examiner, as shown above.

The applicants submit that all presently considered claims are fully allowable under Section 112, second paragraph.

The applicants respectfully traverse the rejection of claims 1-14 under 35 USC 103(a) over Ali et al., in view of Santo et al. These references do not make the presently claimed invention to be obvious.

Before specifically addressing the cited references, the applicants ask the Examiner to consider the following preliminary remarks concerning the field of the present invention.

An ink-receptive layer of an ink-jet recording material can be roughly classified into two types, one of which is a porous ink-receptive layer comprising a pigment such as silica fine particles and a hydrophilic binder such as polyvinyl alcohol as intended by the present invention, and the other is an ink-receptive layer comprising a liquid-absorbing polymer as described in the cited reference of Ali et al. In the former, the ink-receptive layer mainly comprising a pigment and ink is absorbed in the voids between the pigments, while in the latter, the ink-receptive layer comprises a polymer and the polymer itself absorbs ink.

The ink-receptive layer of the present invention mainly comprises a synthetic silica fine particles prepared by a gas phase process (which is called to as "fumed silica" as disclosed on page 2, lines 3-4 of the present specification). According to a preferred embodiment of the present invention, as recited in claims 6 and 8, the ink-receptive layer contains 8 g/m^2 or more of the fumed silica and the ink-receptive layer contains a small amount (i.e., 10 to 30% by weight) of a hydrophilic binder based on the amount of the fumed silica.

In the synthetic silica, there are two type of silicas, i.e., a wet process silica and a gas phase process silica, as disclosed on page 5, lines 25 to 28 of the present specification, and usual silica fine particles mean those prepared by

the wet process in many cases as mentioned on page 5, lines 28-29 of the same. The fumed silica of the presently claimed invention (which is one of the important features of the present invention) is quite different from the synthetic silica prepared by the wet process (i.e., precipitated silica) not only in the preparation process but also the state of the particles and characteristics of the same. Characteristic features of the fumed silica reside in that it is ultrafine particles having a primary particle size of several nm to several tens nm, and it exists in agglomerated conditions as secondary particles wherein the primary particles are linked in a network structure or a chain state structure. These characteristic features of the fumed silica provides high glossiness and excellent ink-absorption property to the ink-receptive layer. However, since the fumed silica is ultrafine particles, there is a problem in that cracks are likely to be caused at the surface of the ink-receptive layer. This problem becomes significant when the fumed silica having an average primary particle size of 20 nm or less is used in the ink-receptive layer as in the present invention. Also, when a ratio of the hydrophilic layer to be contained in the ink-receptive layer is reduced to make a void volume of the same large, the ink-receptive layer becomes weak and the above problem becomes more significant.

Another important feature of the present invention is that the ink-jet recording material of the present invention uses a water resistant support. The water resistant support is different from a paper support which has conventionally and generally been used, and does not absorb ink. It is important for the ink-jet recording material to have a good ink absorption property to be possessed by an ink-receptive layer. Thus, it is necessary to add a large amount of fumed silica which has good ink absorption property to

the ink-receptive layer. However, when an ink-receptive layer containing a large amount of fumed silica is provided on the water resistant support, cracks of the ink-receptive layer are probable as mentioned above.

Additionally, the ink-jet recording material is required to have water resistant property (water fastness) of a recorded image. That is, it is required for the material that ink printed at the ink-receptive layer shall neither blur nor dissolve out. To improve the water fastness, it has been known to use a cationic polymer as a mordant or a fixing agent. However, if the cationic polymer is used in combination with the fumed silica, it easily aggregates the fumed silica whereby coating workability becomes worse, surface cracks occur and glossiness of the ink-jet recording material becomes low. Also, the cationic polymer improves water fastness but it sometimes provides bad effects on light resistance (light fastness) of the ink-jet recording material.

The presently claimed invention overcomes all the above-mentioned problems involved with the fumed silica and an object thereof is to provide an ink-jet recording material which satisfies required characteristics of water fastness and light fastness simultaneously. That is, the ink-jet recording material of the present invention accomplishes high glossiness, excellent ink-absorption property, prevention of occurrence of cracks, and improved water fastness and light fastness. The above objects of the present invention can be accomplished by formulating fumed silica having an average primary particle size of 20 nm or less and a water-soluble polyvalent metallic compound in an ink-receptive layer. In the present invention, among the water-soluble polyvalent metallic compounds, an aluminum compound, a titanium compound and a zirconium compound are particularly preferred.

Turning now to the cited reference of Ali et al, this reference discloses an invention in which bleeding of ink is decreased and storage of an image over a long period of time is realized even when the image is exposed to a high temperature and high humidity. The ink-receptive layer of Ali contains an ink-receptive polymer and a polymeric mordant comprising a guanidine functionality as mentioned at column 3, lines 22 to 35 of Ali. That is, Ali discloses an ink-receptive sheet of a type absorbing ink in a polymer.

Ali discloses at column 19, lines 58-63, that the ink-receptive layer can include particulate material such as polymeric beads, silica, etc., but they are added thereto to improve handling and flexibility. In this portion of Ali, there is also disclosed that poly(methacrylate) beads are most preferred and the beads are used in the working Examples. A particle size of these particles is described to be 5 to 40 μm at column 20, lines 1-6 of Ali. Thus, the silica used in this reference is a wet process silica, and this is quite different from the gas process silica (or fumed silica) of the present invention. Also, the content of the silica used in Ali is very small as disclosed at column 31, Example 1 (0.15 g of poly(methyl methacrylate) beads having a size of 30 μm was used based on 6 g of the copolymer B. Therefore, this reference does not intend to use a silica with an amount sufficient for making voids in the ink-receptive layer as in the presently claimed invention.

At column 13, lines 13-34, Ali discloses metal ions such as aluminum, zirconium, etc. These metal ions are used to bring about crosslinking of a crosslinkable polymer and a chelating compound as mentioned at column 13, lines 8-13 of the reference.

In contrast, the water-soluble polyvalent metallic compound of the

presently claimed invention is used to reduce surface cracks as well as improve water fastness and light fastness. Also, in the present invention, the combined use a hydrophilic binder and a crosslinking agent thereof prevents effects on surface cracks, bleeding under high humidity, peeling of surface, etc. resulting in significant improvement of quality. Of the crosslinking agents, boric acid or borate is particularly preferred.

As explained in detail above, Ali neither intends the porous ink-receptive layer nor describes the fumed silica employed in the presently claimed invention. Moreover, the object of using the water-soluble polyvalent metallic compound of the present invention and that of Ali are quite different from each other.

Accordingly, the presently claimed invention is no where disclosed, suggested or made obvious by the teachings of Ali et al. The presently claimed invention is fully allowable under Section 103(a) in view of Ali et al.

The presently claimed invention has been shown to clearly distinguish over the teachings of Ali et al. The teachings of Santo et al. do not remedy the deficiencies of Ali.

Santo refers to non-essential components of the presently claimed invention. For example, Santo discloses silica fine particles synthesized by a gas phase reaction at column 4, lines 62-63 thereof. However, Santo provides no description about the water-soluble polyvalent metallic compound. Santo is irrelevant to the presently claimed invention.

The presently claimed invention is fully allowable under Section 103(a) in view of the cited prior art.

At page 5 of the Office Action, the Examiner asks the applicants to submit a copy of the product bulletin of the compound represented by the formula I as shown in claim 12. The applicants accordingly attach a copy of the bulletin, "Aldrich Structure Index." In the bulletin, please see the next to last compound at the left side on page 147. This compound corresponds to Compound (I-1) disclosed at the bottom of page 13 of the present specification.

In view of the above and the attached product bulletin, it is believed that this application is in condition for allowance and a Notice to that effect is respectfully requested.

The applicants have attached an Information Disclosure Statement to this Amendment with PTO Form 1449 and copies of cited documents. Official entry and consideration are respectfully requested.

Allowance of this application is requested.

Respectfully submitted,

Manelli Denison & Selter, PLLC

By _____

Paul E. White, Jr.
Reg. No. 32,011
Tel. No.: (202) 261-1050
Fax No.: (202) 887-0336

2000 M Street, N.W.
Seventh Floor
Washington, D.C. 20036
(202) 261-1000

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Proposed Amendments To Claims 1, 2, 4, 7, 12 and 14 Showing Deletions And Insertions.

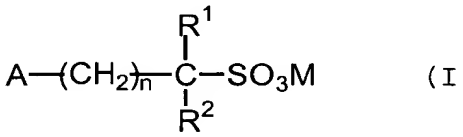
Claim 1. (Amended) An ink-jet recording sheet which comprises a water resistant support and at least one ink-receptive layer provided on the support, wherein at least one of the ink-receptive layer contains synthetic silica fine particles prepared by a gas phase process having an average primary particle diameter of 20 nm or less and at least one water-soluble polyvalent metal compound.

Claim 2. (Amended) The ink-jet recording sheet according to claim 1, wherein the water-soluble polyvalent metal compound is selected from the group consisting of a water-soluble aluminum compound and a water-soluble compound containing an element [of Group 4 of the Periodic Table] selected from the group consisting of titanium and zirconium.

Claim 4. (Amended) The ink-jet recording sheet according to [claim 1] claim 2, wherein the water-soluble aluminum compound is polyaluminum hydroxychloride.

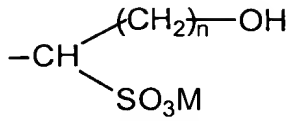
Claim 7. (Amended) The ink-jet recording sheet according to [claim 3] claim 1, wherein the average primary particle diameter of the synthetic silica by the gas phase process is 20 nm or less and a specific surface area measured by the BET method is 200 m^2/g or more.

Claim 12. (Amended) The ink-jet recording sheet according to claim 1, wherein the ink-receptive layer contains at least one compound selected from the group consisting of a nitrite, a sulfite, a bisulfite, a phosphite, a thiosulfate and a compound represented by the following formula (I):



(I

wherein A represents a hydroxyl group or an amino group which may be substituted by an unsubstituted or substituted alkyl group having 1 to 4 carbon atoms, or an unsubstituted or substituted aryl group; R^1 and R^2 are combined to form a 5- or 6-membered ring with the carbon atom to which they are bonded, or one of which represents a hydrogen atom and the other represents a hydrogen atom, an alkyl group having 1 to 17 carbon atoms, an aryl group which may be substituted by at least one of a hydroxyl group or $-SO_3M$, or a group represented by the following formula (II); n represents 0 or an integer of 1 to 8; and M represents a cation,



(II

where n and M have the same meaning as defined above.

Claim 14. (Amended) The ink-jet recording sheet according to [claim 13] claim 1, wherein the water resistant support is a polyolefin resin-coated paper.